JunoCam images at PJ18: Part I.

John Rogers (2019 March 31)

PJ18, on 2019 Feb.12, was a Gravity flyby like PJ15 and PJ17, with the same limitations on JunoCam's viewing angle, but a full set of images was again taken from pole to pole. On the inbound leg, Juno captured a view of Io that is very similar to the one taken at PJ17, and shows the same volcanic plume sunlit on the terminator, still erupting in Chalybes Regio (Figure 1).

Juno's orbit has gradually evolved away from its initial orthogonal position. The inclination has come down, by an average of ~0.5 deg/PJ, from 90 deg to 80 deg (retrograde), and the latitude of perijove has increased, now being over the N. Tropical Zone. On PJ18, the moment of perijove (closest approach to Jupiter's centre) was at 17h 34m 16s (UT at spacecraft), at L3 = 235.3, 18.9°S, altitude 3499 km; but because of Jupiter's oblateness, minimum altitude was 1m 27s later and 102 km lower, at L3 = 237, 15°S, altitude 3397 km; then equator crossing came 7m 17s after perijove, at L3 = 243.3 (L1=322.5, L2=304.3) , altitude 5060 km. (Thanks to Stuart Stephens of the Juno team for the information.)

A set of ground-based images covering the GRS and the sub-spacecraft track is posted in our 2019 Report no.2 (https://britastro.org/node/17341), and a few are shown here in Figure 2. Notably, the track passed ~3 deg f. the f. end of the GRS [f. = following = west]. Juno passed over L3=252.4 at 20°S; the GRS was centred at L3=241.6 (±0.4°) and ~14-16° long. So the images cover the whole of the GRS. A global cylindrical map, compiled from Gerald's map projections of the JunoCam images, is Figure 3. (This report does not describe the polar regions, which will be covered in a later supplement.)

Northern domains

N6 domain: The Bland Zone (60-65°N) exhibits exemplary blandness around much of the PJ18 map, and this sector was viewed particularly well in closeup images (Figures 4 & 5, image 26), though there is also a shorter disrupted sector.

N5 & N4 domains (Figures 4 & 5, image 26): These are entirely chaotic as usual, with large FFRs. In each domain (and also in the NTB(N), and in the SPR at 65.5°S), one FFR contains an extremely bright convective spot; in N4 and lower-latitude examples, this is evidently made of popup clouds. In N5, there is a whole cluster of tiny anticyclonic vortices entangled with a FFR. In N4 there are some notable well-defined cyclones (two brown, one orange).

N3 domain (Figures 4 & 5, image 30, & Figure 6): This is mostly very bland, though with a texture different from the N6 domain. There is a striking row of cyclones and anticyclones of various colours. Oddly, most of these are in the southern (normally cyclonic) half of the domain, leaving a broad bland zone between these N3 circulations and the N4 FFR; this 'N3TZ' straddles the expected position of the N4 jet, whose position is not obvious from the intricate small-scale cloud textures. Two anticyclonic ovals in N3 are notable: (1) an extremely bright anticyclone with popup clouds (L2 = 283); (2) an orange oval (Little Red Spot) (L2 = 319). (Both of these were well tracked by JUPOS in 2019 Jan-Feb., but cannot be definitely identified with anything in 2018. Neither oval is visible in ground-based methane images at PJ18, but these did not have high resolution.)

N2 domain: The main feature is a dark segment of NNTB (Figure 6), which can be called a long 'barge', similar to the one imaged at PJ15 (but far away in longitude), but it appears much greyer. Like that one it has rather diffuse streaks or patches of light-coloured clouds overlying the very dark 'barge'. There is a FFR following it.

N1 (N. Temperate) domain: The NTB was only viewed obliquely, but again showed a FFR with an extremely bright convective cloud patch. It's notable how the orange NTB(S) has faded and shrunk in latitude during the course of the Juno mission.

N. Equatorial Belt (NEB) & Equatorial Zone (EZ)

The NEB is rather quiet internally in these images, but on the NEBs edge there is a large dark formation ('hot spot') with complex cloud features f. it (occupying the left-hand half of the NEBs/EZ(N) in the hi-res map in Figure 9.) This formation was exceptionally complex and dynamic in ground-based images as well (Figure 2: see our 2019 Report no.3: https://britastro.org/node/17638). A similar one was imaged at PJ13.

The view to the horizon over the NEB shows high-altitude haze more distinct over the N. Tropical Zone (Figure 7).

The EZ itself is covered with swathes of different colours, a dramatic scene now that the ochre coloration has spread across most of its width, intermingled with diverse white cloud streaks and blue-grey streaks (Figures 8 & 9). Even though the view is now very oblique and therefore more distant than before, bands of mesoscale waves can be seen in the form of either white or ochre striations over some of the dark grey streaks (Figures 8 & 9).

S. Equatorial Belt (SEB) & Great Red Spot (GRS)

Juno flew just ~3 deg. longitude f. the f. end of the GRS, and obtained good views of the GRS itself, and of the convective 'rifted region' of SEB f. it. A map of this by Kevin Gill is in Figure 10. A contextual account of the region, illustrated with ground-based images from Feb.6-21, has been posted as our 2019 Report no.2 (https://britastro.org/node/17341). Three of these images are copied in Figure 2, with Juno's track approximately marked.

In the 'rifted region' of SEB f. the GRS, activity had been sputtering on at a low level in recent months. Juno's PJ18 images showed three such spots to be small brilliant plumes. Ground-based images showed that most of these were new; previously there had only been one or two such spots, and by Feb.21 there were up to four such spots, becoming more conspicuous. So Juno caught the region during an upsurge in this activity.

The most notable feature of the GRS in Figure 10 is the red streak or 'bridge' that appears to be streaming out of its f. end – as also seen in the PJ17 images. In the ground-based images alone, the streak was so small that one would not have noticed anything unusual, though on Feb.12, it was just resolved (bright) in I-band and CH_4 images by Phil Miles. Nevertheless, PJ18 confirms that this has recently become a frequent phenomenon, as if such streaks are being shredded off the periphery the GRS near its f. end. Looking back through some maps from Hubble, no such feature was recorded in 2014, 2015 or 2016; but the maps of 2017 Feb.2 showed a similar red feature, and the GRS periphery has also appeared ragged in subsequent Hubble images.

Southern domains

S1 (S. Temperate) domain: The images (e.g. Figure 11) provided an excellent map of the structured sector f. oval BA (Figure 3), which is put into ground-based context in our 2019 Report no.3 (https://britastro.org/node/17638). It includes the disturbed and darkened sector of STZ; this and the AWO within it have exceptionally bland cloud texture (Figure 12), contrasting with the typical spiral cloud texture in the AWOs of the S2 domain.

The higher domains, as usual, display a wide range of complex activities (Figure 11). These include a little cyclone with a remarkably dark brown spot at its centre, in the SSTB (Figure 12), and a long series of FFRs in the S3 domain (Figure 11).

The South Polar region will be described in a subsequent Part II of this report.

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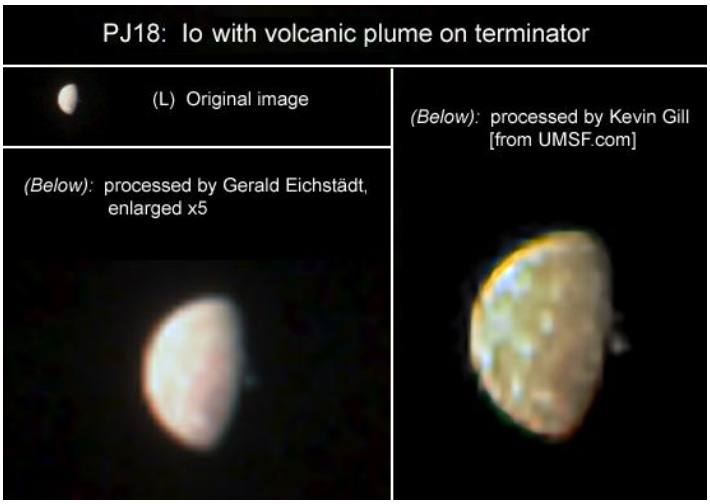

Figure 1.

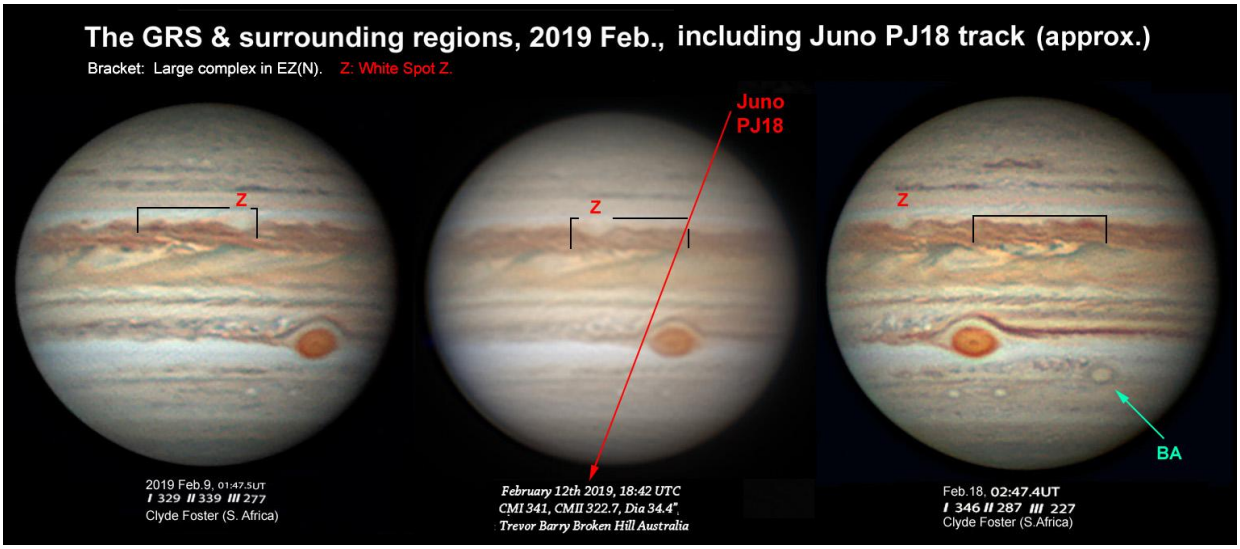

Figure 2.

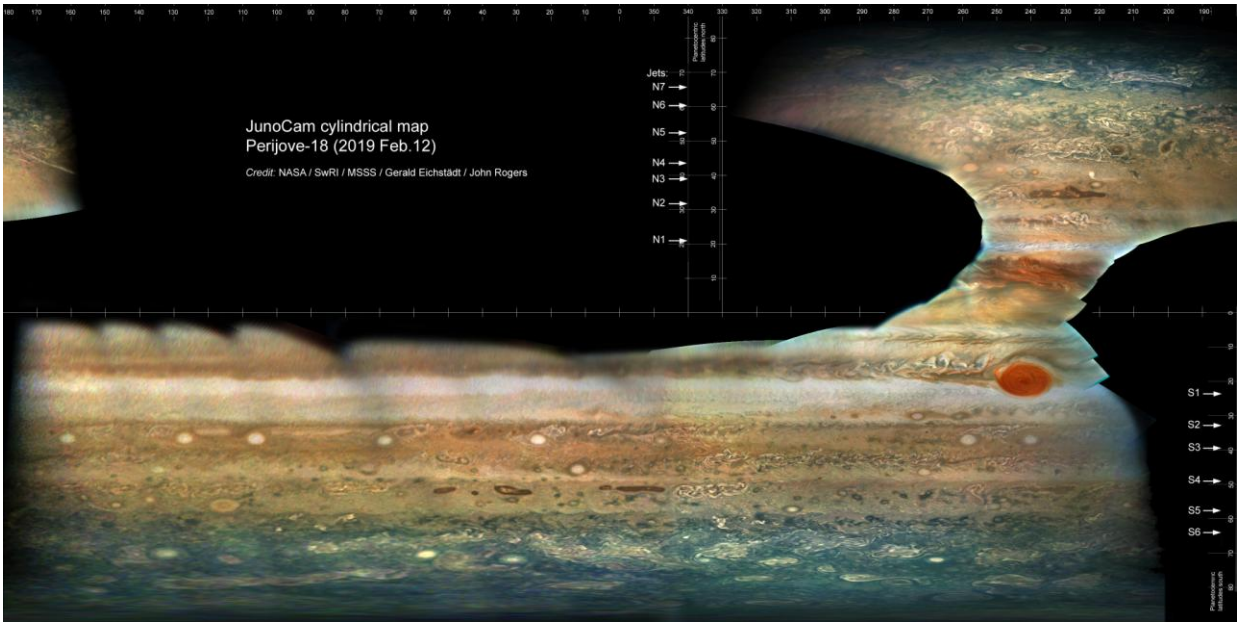

Figure 3.

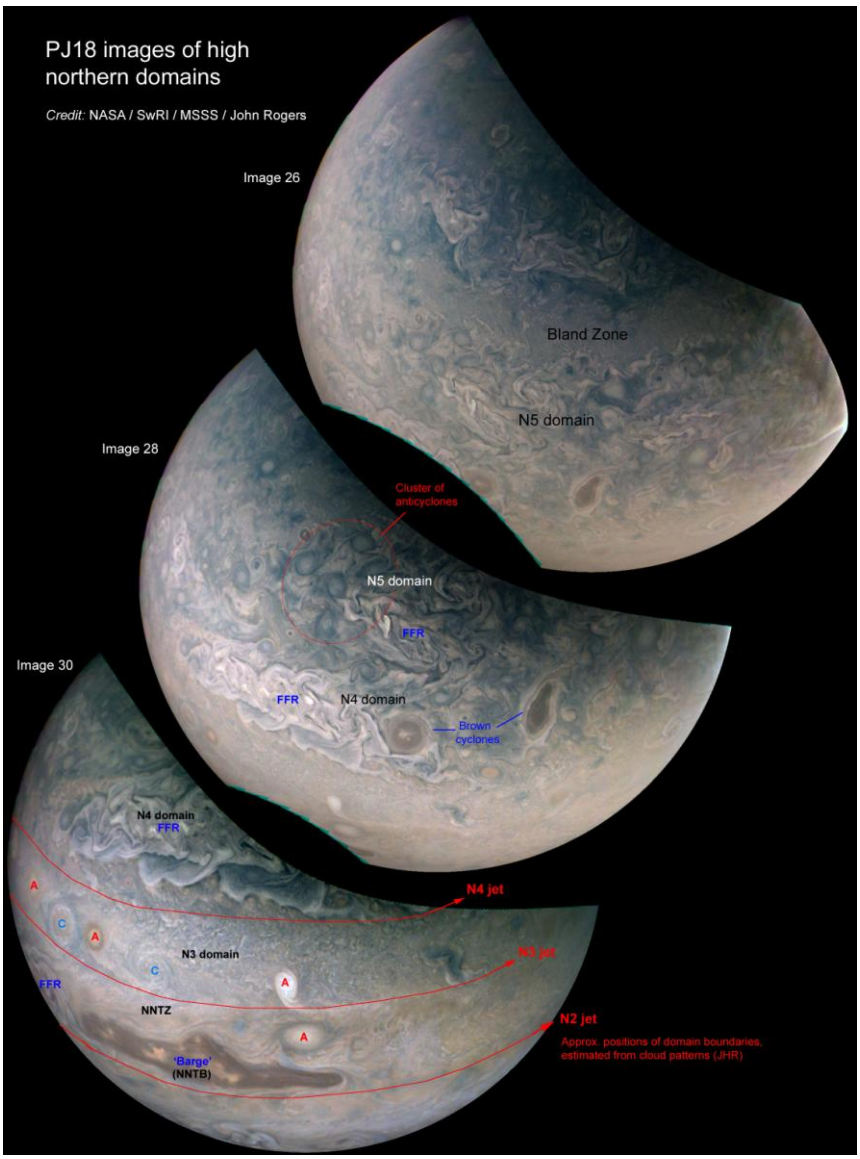

Figure 4.

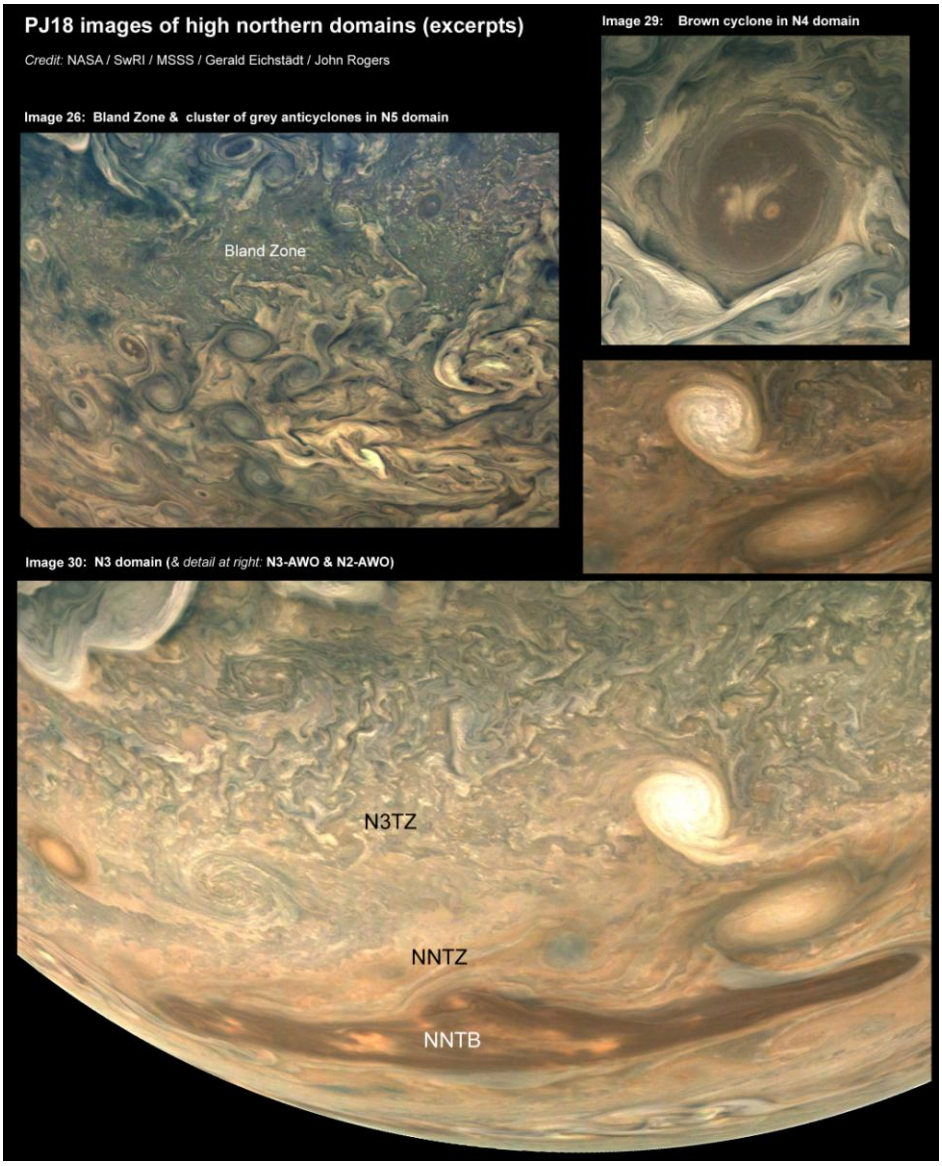

Figure 5.

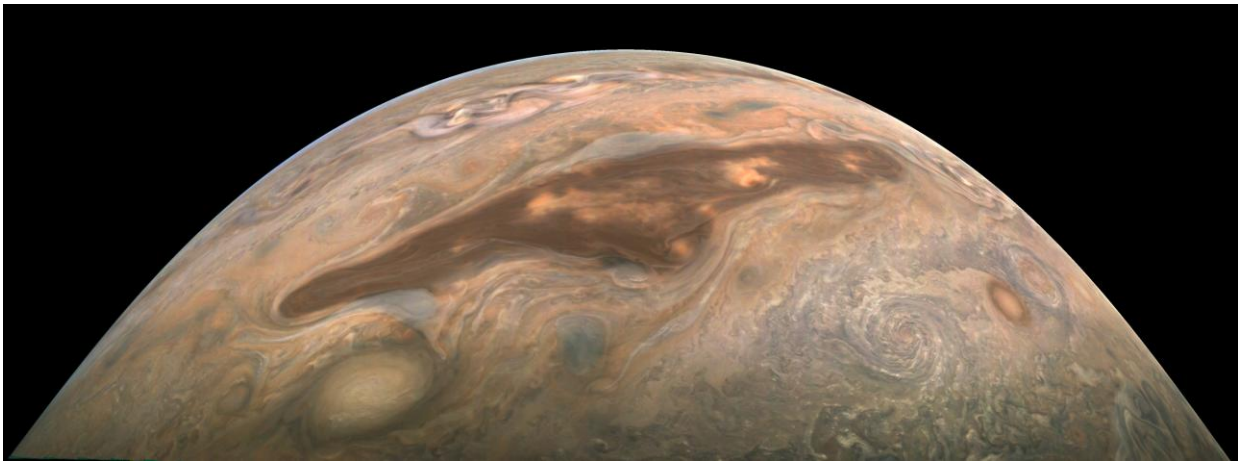

Figure 6. The NNTB segment and some N3 circulations in image 31. For perspective reasons, south is up, opposite to previous figures. (*Credit:* NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers)

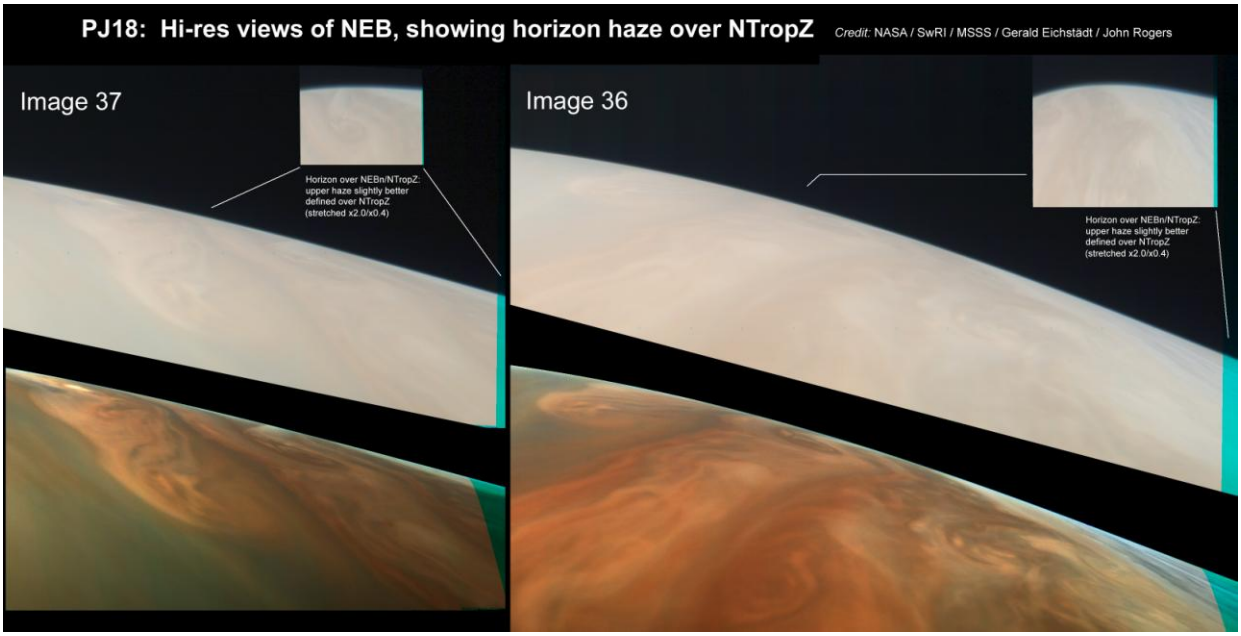

Figure 7.

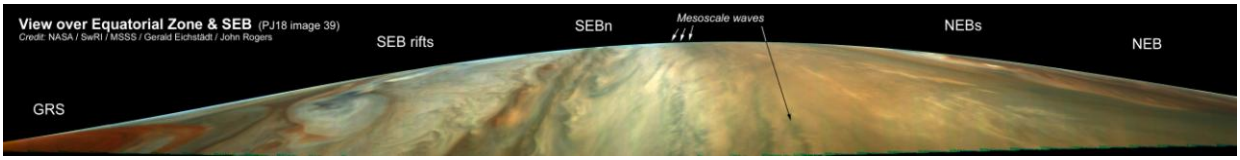

Figure 8.

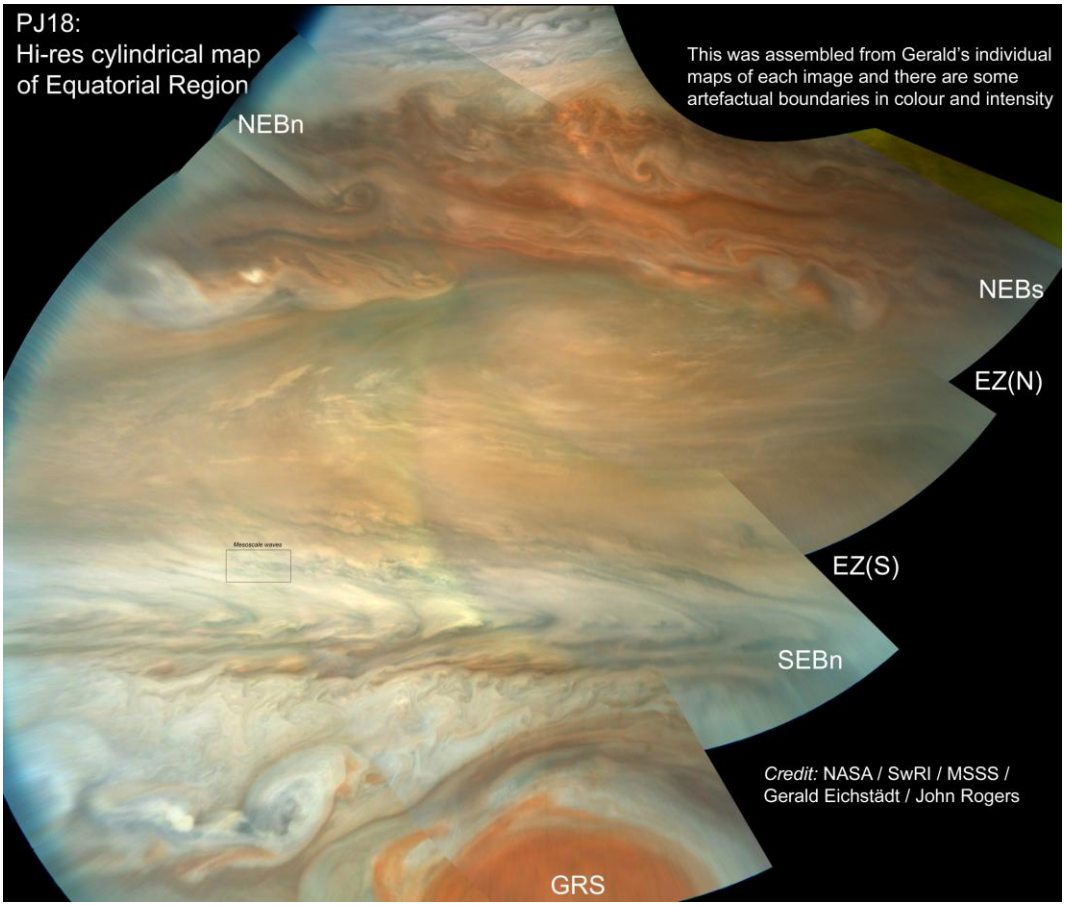

Figure 9.

Figure 10.

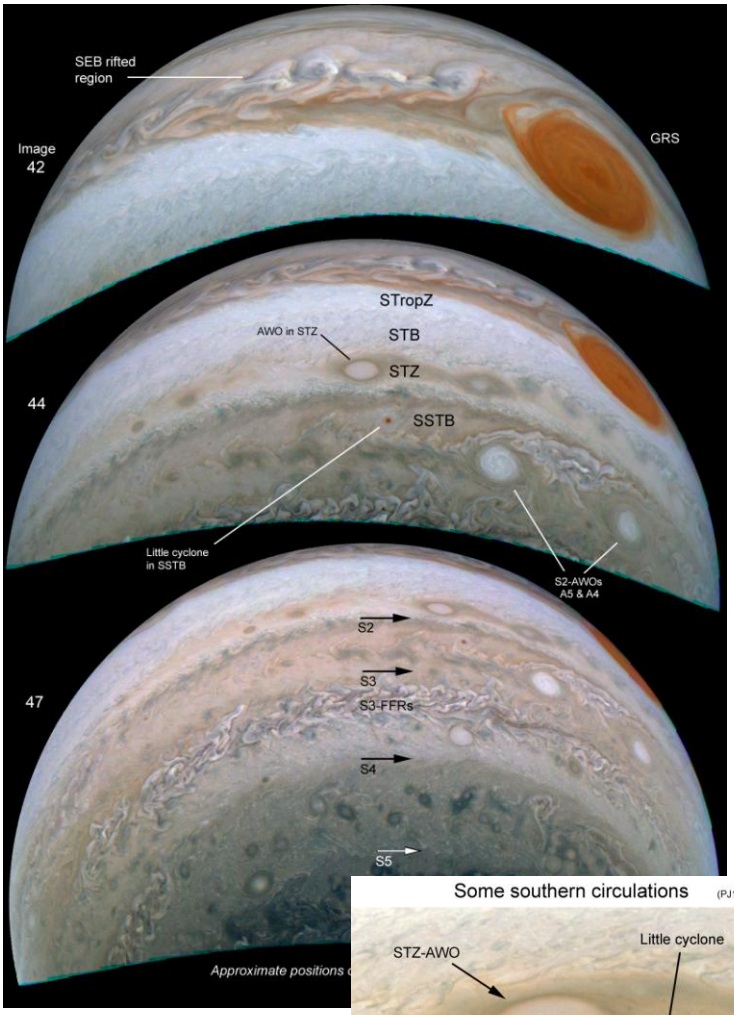

Figure 11.

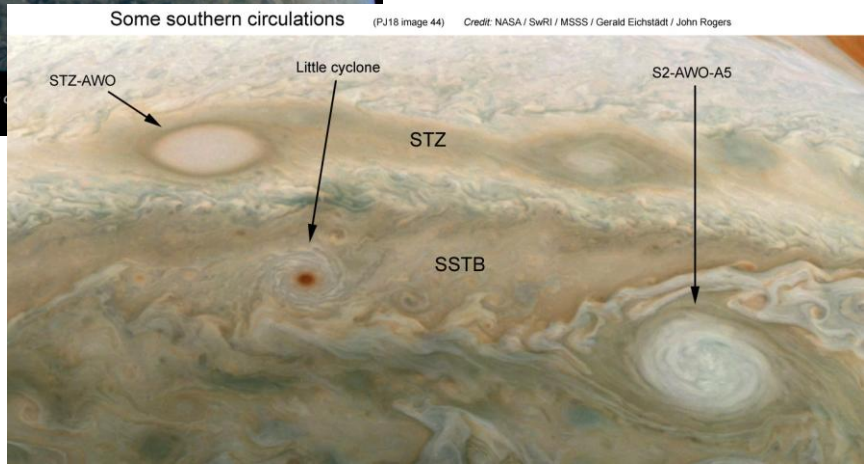

Figure 12.